THE USE OF THE MAXIMUM AEROBIC SPEED VALUE (MAS) DURING THE TRAINING PROCESS

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Abstract
Given the importance of training, the development and maintenance of this fundamental physiological dimension should be the permanent motivation of any sportsperson or sports instructor for the harmonious development of young people they are responsible for and for anyone interested in maintaining a good health condition which is often synonymous with physical well-being and better health. For the same reason, the direct measurement or estimation of VO2 max should normally be a constituent part of any general or specific physical capacity assessment of any people: young or old, sedentary or interested in sports, in the best possible use of its capital or its health.
Key words: *aerobic, training, process, speed*

INTRODUCTION

The relationships between maximal aerobic speed, VO2 max and lasting jogging performance allow finding one's value, based on the value of the other. Finding MAS value helps to determine more easily the intensity of training and individualize it with greater precision.

Knowing the value of MAS can help us to anticipate with high enough precision that we can achieve performance while running if you follow, of course, a proper training programme, in order to develop the strength required for performance and if the jogging efficiency is not satisfactory.

If you know MAS or VO2 max, depending on regressions calculated by Leger, Mercier and Gauvin (1984), we find that we can achieve performance on different distances.

General information on maximal aerobic speed (MAS) and VO2 MAX

The maximal aerobic speed results from the combination of VO2 max and the energy consumption at a certain speed. In other words, the less energy is consumed in order to run a certain speed, more effective is the race. For an adult, during a running course, there are differences in the individual efficiency can reach up to 5%. This difference is relatively modest, if compared to those observed in swimming and cycling. This is why, when knowing the maximum aerobic speed of a race and assuming the average efficiency, the VO2 max can be calculated using the formula given by Léger and Mercier:

$$\text{VO2 max } (ml.kg^{-1}.min^{-1}) = \text{VAM } (km/h) * 3.5 \quad (1)$$

And the other way round, one can calculate the AMS value if they know the VO2 max:

$$\text{VAM } (km/h) = \frac{\text{VO2 max } (ml.km^{-1}.min^{-1})}{3.5} \quad (2)$$

As an example, a person who reaches the speed of 20 km / h should have a VO2max of 70 $ml.kg^{-1}.min^{-1}$.

But as there are always differences concerning race efficiency, this value can only be "average".

The less "economical" people should have real values for VO2 max, higher than this value, although many very good athletes can run as fast with lower oxygen consumption.

It is also to be taken into account the fact that in comparison with an adult, a teenager and a child lose an average of 2% of race efficiency every year for those under the age of 18.

The VO2 max measure can be expressed in different units:

- If we need a gross or total measure, we use the number of litres of oxygen consumed per time unit, usually minutes (min), which gives the unit = $l.min^{-1}$. The greater and the heavier the subject is, the higher the value of his VO2 max measured in litres per minute normally is. This is not surprising, if we consider that a greater muscle mass uses more oxygen, but this does not constitute a sufficient indicator of the physical capacity. For example, an athlete 190 cm high and weighing more than 90 kg it is often prone to provide a VO2 max of 5 $l.min^{-1}$, while an athlete with a body weight of 65 kg, will only indicate, on average, a VO2 max value between 4 and 4.5 $l.min^{-1}$. Thus, in terms of aerobic capacity, the athlete is more efficient.
- Therefore, if we want to evaluate an athlete's aerobic physiological capacity, depending on their discipline, it is advisable to measure the flow rate of O2 consumption reported in pounds of muscle mass, or, as physiologists propose, relative to kilos of fibre (the total weight minus the weight of the fat mass) or, more simply, which is the most affordable and the most classic case, relative to kilos of body weight. In this case, the measurement unit is: oxygen ml per kilo of body weight, $ml.kg^{-1}.min^{-1}$.

For example, if we have a value of MAS of 18 km / h, thus a VO2max of 63 ml.kg^{-1}min^{-1}, or if the VO2 max was measured directly in the laboratory, provided a specific training was followed, we can reach (with a margin of error of ± 5-7%) the following performances: 2 min 17 s to 800 m; 2 min 59 s per kilometre; 4 min 50 s at 1500 m; 6 min 42 s at 2000 m; 10 min 38 s to 3 km; 18 min 30 s to 5 km; 39 min 18 s to 10 km.

Thus, depending on the distance, performance from the combination of several factors:

- the aerobic capacity
- the maximal aerobic speed VO2 max + race economy
- the aerobic endurance → {
- the motivation

Since the physiological aerobic capacity involves the proper functioning of many vital organs: lungs, vessels, heart, and shows indirectly the combustion quality, in most research on the subject of physiological adaptations related to exercise and workout, the importance of maximum oxygen consumption (VO2 max) is one of the objective criteria often taken into account in assessing the level of fitness.

- In everyday life, enabling higher daily activity without causing excessive fatigue, the VO2 max properly developed in an adult or a young adult, and more obvious in an athlete, is a solid guarantee of good general physical condition.
- For many physical activities and sports disciplines, the relationship between long-term performance and the ability to use large quantities of oxygen is a fact. A good VO2 max not only promotes long-term performance but also may indirectly favour allowing prolonged training, and the quality of any other performances.
- Thus, whatever the individual motivations related to the practice of physical activity, a good transport and good cellular use of oxygen plays a crucial role in recovery following the exercise.

Their common principle is to increase progressively, by setting longer and longer distances, the power and speed of movement in order to reach an individual limit determined by the maximum oxygen consumption (VO2 max). It is possible that only the speed and force values to be recorded at the last distance required, and / or to calculate VO2 max.

In all these cases it is necessary to firstly define the objective of the evaluation in order to choose the distance that best suits the situation.

- A diagnosis needs to be set or a general control generally must be undergone, in a more explicit way, at the beginning of a sports season. In this case, knowing the simple index of maximum aerobic power is enough.
- In addition, one needs to achieve individual data in order to determine the exercise intensity. In this case, knowing the value of the maximum aerobic speed is essential. Other running distances for assessing aerobic resistance

Correlative aspects between MAS and VO2 max. Examples of tests for their determination

Three types of tests allow assessing aerobic resistance: two tests at "infra-maximal" speeds and a test of maintaining the MAS value as much as possible.

- **Test 1**: Long-term infra-maximal or distance-required speeds

In this type of test it is required to maintain the highest percentage of MAS for a period or a given distance: races of 6, 9 or 12 minutes or 2400 m (Cooper, 1968).

In order to calculate the aerobic strength, it is sufficient to compare the distance you've travelled theoretically if we managed to maintain the MAS with the actual distance travelled during the test. We will subsequently determine the percentage between the two results.

Consider the following examples:

- *Example 1*: Consider a person whose MAS is 16 km / h and through 3 km in 12 minutes. The theoretical distance travelled in 12 min with maximum aerobic speed:

$$\frac{16\ (km/h) * 12\ min}{60\ min} = 3.2\ km$$

The percentage of the aerobic endurance is:

$$\frac{3 * 100}{3.2} = 94\%$$

On the other way round, this percentage can be calculated starting from the speed of the race:

$$\text{Real average speed} = \frac{3 * 60}{12} = 15\ km/h$$

The calculation of the percentage or of the aerobic endurance index:

$$\frac{\text{Real average speed} * 100}{VAM} = \frac{15 * 100}{16} = 94\%$$

- *Example 2* : the MAS value is 17.5 km/h and you run 2400 m in 8 min 36 s, a.k.a. 516 s. The calculation of our real speed on a distance of 2400 m is:

$$\frac{2.4 * 3600}{516} = 16.74\ km/h$$

$$\text{Your aerobic endurance index} = \frac{16.74 * 100}{17.5} = 95.68$$

• **Test 2**: the percentage of MAS needs to be maintained as much as possible

We will set a speed race close to the value corresponding to the MAS percentage (90-95% or higher) you will need to maintain as much as possible. The time in which we can maintain this speed is aerobic resistance index. This speed can be calculated immediately and the appropriate signals placed at chosen intervals can be issued with a newly emerging device.

Choosing the speed for each desired percentage of MAS and crossing times at regular intervals can also be obtained by using a special program (VAMEVAL) or using reference tables attached below.

• **Test 3**: Maximum rhythm imposed (MRI) (Gacon, 1987).

In this test, as in the previous one, the maximum length of the run at a maximum aerobic speed is the aerobic endurance index.

Taking into account the conduct of the proposed test, Cooper test is very useful in measuring the aerobic resistance, but it does not help finding the value of the VO2 max value as stated by many authors.

Table 1. The calculation of the VO2 max and the anticipation of the running performances on certain distances according to this value

MAS	**VO2max**	**Time** (h:min:s) according to the race distance										
Km/h	ml/min/kg	800m	1000m	1500m	2km	3km	5km	10km	15km	20km	30km	42195km
8	28.0	5:30	7:26	13:30	19:25	31:33	56:49	2:39:14	4:14:28	5:54:46	14:27:5	31:41:25
9	31.5	4:50	6:28	11:27	16:19	26:22	47:07	2:02:00	3:12:59	4:27:00	3	16:35:05
10	35.0	4:18	5:43	9:56	14:04	22:38	40:10	1:38:53	2:35:25	3:34:03	9:11:57	11:13:52
											6:44:38	
11	38.5	3:52	5:08	8:46	12:22	19:50	35:02	1:23:08	2:10:06	2:58:38		8:29:26
12	42.0	3:31	4:39	7:51	11:02	17:39	31:04	1:11:43	1:51:52	2:33:52	5:19:24	6:49:30
13	45.5	3:14	4:16	7:07	9:58	15:54	27:54	1:03:03	1:38:07	2:14:13	4:33:16	5:42:21
											3:44:43	
14	49.0	2:59	3:56	6:30	9:05	14:28	25:20	56:15	1:27:23	1:59:22		4:54:07
15	52.5	2:46	3:38	5:59	8:20	13:16	23:11	50:47	1:18:46	1:47:29	3:15:43	4:17:48
16	56.0	2:35	3:24	5:32	7:43	12:15	21:23	46:17	1:11:42	1:37:45	2:53:30	3:49:28
											2:35:33	
17	59.5	2:26	3:11	5:09	7:10	11:23	19:50	42:30	1:05:47	1:29:38		3:26:44
18	63.0	2:17	2:59	4:50	6:42	10:38	18:30	39:18	1:00:47	1:22:46	2:21:05	3:08:06
19	66.5	2:10	2:49	4:32	6:17	9:58	17:20	36:33	56:29	1:16:52	2:09:06	2:52:34
											1:59:57	
20	70.0	2:03	2:40	4:17	5:56	9:23	16:18	34:10	52:45	1:11:45		2:39:23
21	73.5	1:57	2:32	4:03	5:36	8:52	15:23	32:04	49:29	1:07:17	1:50:18	2:28:05
22	77.0	1:51	2:25	3:50	5:19	8:24	14:34	30:12	46:36	1:03:20	1:42:49	2:18:16
											1:36:17	
23	80.5	1:46	2:18	3:39	5:07	7:59	13:50	28:33	44:01	59:30		2:09:41
24	84.0	1:42	2:12	3:29	4:49	7:36	13:10	27:04	41:43	56:41	1:30:32	2:02:06
25	87.5	1:37	2:06	3:20	4:36	7:15	12:34	25:44	39:39	53:51	1:25:26	1:55:21
											1:20:53	

If you know the value of the MAS, this table indicates the VO2 max and the performance that you get on some of the distances between 800 m and 15 km of the marathon. However, as the distance is shorter (800, 1000, 1500 m), the anaerobic component intervenes and modifies the accuracy of this data. But as the distance is longer (5, 15 km), the economy race occurs (the minimum consumption for a given speed) and aerobic resistance.
If you know your performance on one of the previous distance, you can determine the VO2 max.

In conclusion, well developed maximum oxygen consumption is the guarantee of a good physical condition and so we can consider:

Because the direct measurements of VO2 max based on laboratory tests performed on the medical bicycle, on the treadmill or on any other ergo meter device, are too expensive relatively to useful and usable information that they provide more often now, coaches, athletes and doctors working in sport field are interested in learning the benefits of all the available results of a number of field tests.

The development of the aerobic endurance is necessary in order to increase the capacity of physiological chain required for transport oxygen from the lungs to the muscles which need oxygen.

The result will therefore be: improved ability to extract oxygen from the lungs, an increase in haemoglobin (which carries oxygen in the blood), a development of cardiac output and better efficiency of the heart (for a given intensity of exercise frequency heart rate decreases as the athlete is becoming better workout), and especially the multiplication of capillaries that supply better blood and oxygen, and thus a more rapid elimination of waste (resulting from metabolism) of muscle produced during the year.

The development of resistance is a good aerobic training of the "physiological field" of athletes involved in the process of development who will then be able to safely grow throughout the school year or sport season, sports career, or even their lives, all the qualities needed to develop biological and motor or their sports practice.

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